Test #	Sub-ject	Sled End Vel. (ft/sec)	Sled Accel. Plateau (G)	Sled Accel. Peak (G)	Subject Head Accel. Peak (G)	Input Pulse Duration (M-sec)	Sled rate of G onset (G/sec)	Subject rate of G onset (G/sec)	Shoulder Strap Load (lbs) Right	Shoulder Strap Load (lbs) Left	Thigh Strap Load (lbs) Right	Thigh Strap Load (lbs) Left	Remarks
1	G	6.9	1.9	1.9	5.0	151	204	263	29	11	84	75	Subject did not participate in rest of program.
2	F	6.9	1.8	1.8	4.0	150	225	250	30	27	71	62	Subject did not participate in rest of program.
3	A	6.9	1.8	1.8	4.6	149	257	270	37	26	97	83	
4	B	6.8	1.9	1.9	5.4	150	190	208	26	27	80	88	
5	C	6.9	1.8	1.8	6.0	152	212	261	21	9	108	77	
6	D	6.8	1.9	2.0	4.3	150	292	116	43	40	26	31	
7	E	6.7	1.9	1.9	4.3	150	242	195	23	20	34	17	
8	A	9.6	3.2	3.2	8.4	112	480	550	87	97	84	64	
9	B	9.6	3.3	3.5	6.6	113	425	233	83	61	13	20	
10	C	9.6	3.3	3.5	8.7	112	443	410	90	79	66	45	
11	E	8.5	2.8	2.8	5.2	153	338	217	35	26	60	52	← Irradic Catapult perf. giving double acceleration pulse.
12	D	9.4	3.2	3.2	6.9	123	325	203	66	62	61	53	
13	A	10.1	3.7	4.0	9.1	128	505	588	60	71	78	65	←
14	B	11.1	4.8	4.8	5.8	100	800	263	96	72	42	39	
15	C	11.1	4.4	4.7	8.9	105	845	268	111	82	38	45	
16	E	11.2	4.8	5.0	9.9	102	820	323	95	86	105	119	
17	D	11.3	4.8	5.1	9.3	98	1080	295	108	81	90	109	
18	B	12.3	5.7	6.3	12.1	96	1590	199	127	112	54	55	
19	C	12.3	5.7	6.1	9.9	98	1550	331	132	117	80	61	
20	D	12.4	5.9	6.3	9.7	97	1420	210	112	105	157	133	

TABLE 3 Page 1 - Acceleratic & Load Data

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Test #	Sub-ject	Sled End Vel. (ft/sec)	Sled Accel. Plateau (G)	Sled Accel. Peak (G)	Subject Head Accel. Peak (G)	Input Pulse Duration (M-sec)	Sled rate of G onset (G/sec)	Subject rate of G onset (G/sec)	Shoulder Strap Load (lbs) Right	Shoulder Strap Load (lbs) Left	Thigh Strap Load (lbs) Right	Thigh Strap Load (lbs) Left	Remarks
21	E	12.4	5.9	6.4	9.7	97	1375	371	112	99	142	93	
22	B	12.9	6.4	6.4	6.7	98	1140	404	135	121	72	76	Irradic catapult performance giving double accel. pulse
23	C	13.7	6.3	6.9	13.0	85	2520	472	152	124	114	132	
24	D	13.9	6.9	7.3	10.8	84	2960	472	132	104	170	167	
25	E	14.0	6.9	7.6	11.2	84	2760	415	152	120	172	151	
26	B	14.5	8.2	8.2	11.3	84	2000	180	129	120	103	106	
27	C	14.4	7.8	8.3	12.7	86	1690	264	157	155	155	202	
27	D	14.4	8.2	8.6	10.6	84	2280	398	125	120	199	210	
29	E	14.5	8.2	8.2	13.4	83	2370	618	113	111	206	195	
30	B	14.7	8.6	8.9	10.3	79	2900	370	145	123	173	191	
31	C	14.4	8.0	8.5	12.1	88	2110	241	135	124	105	125	
32	D	14.8	8.7	8.9	10.8	84	2470	402	90	112	197	224	
33	E	14.9	8.7	8.7	12.0	83	3330	204	113	112	210	189	
34	B	15.9	9.5	9.9	14.0	73	7500	750	126	110	189	208	
35	C	15.9	9.5	9.9	18.1	72	5930	855	206	184	189	197	
36	D	15.9	9.7	10.0	13.6	73	6750	278	133	135	294	266	
37	B	17.0	10.7	10.7	14.9	70	8140	426	159	170	292	286	
38	D	17.0	10.5	11.0	15.8	70	6300	465	161	168	310	302	
END OF PHASE I													
39	C	10.6	4.3	4.5	9.1	99	1060	226	85	84	82	72	Experimen-tation with NASA helmet.
40	C	13.8	7.3	8.1	14.2	80	3110	592	137	140	191	165	
41	D	10.5	4.3	4.5	6.9	99	1010	218	64	57	134	132	
42	D	10.5	4.3	4.5	6.8	99	1080	202	50	58	103	124	
43	D	10.6	4.3	4.6	6.2	99	1035	166	57	64	136	126	
START OF PHASE II													
44	D	11.4	5.0	5.3	8.0	99	208	228	36	33	145	128	

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Short linear impact zone

$0 < \frac{t_1}{T_n} < 0.4$, $\Delta V = V_o$

Here, t_1 = durat. of impact = 0.05 – 0.10 sec. (covers range of input pulse times in this rpt.)

T_n = nat. pd. of spring mass syst. $\frac{1}{5} = 0.2$ sec

Test #	Subject	Sled End Vel. (ft/sec)	Sled Accel. Plateau (G)	Sled Accel. Peak (G)	Subject Head Accel. Peak (G)	Input Pulse Duration (M-sec)	Sled rate of G onset (G/sec)	Subject rate of G onset (G/sec)	Shoulder Strap Load (lbs) Right	Shoulder Strap Load (lbs) Left	Thigh Strap Load (lbs) Right	Thigh Strap Load (lbs) Left	Remarks
45	H	11.1	4.7	5.1	10.9	94	214	335	128	115	135	146	Subject did not participate in rest of program.
46	I	11.1	4.6	4.9	10.5	97	250	374	144	131	120	120	
47	D	12.8	5.5	6.2	10.7	90	280	318	98	104	203	203	
48	I	12.8	5.7	6.2	12.1	91	238	450	180	173	131	129	
49	B	13.0	5.8	6.3	10.9	91	270	232	171	158	208	182	
50	D	15.4	8.9	9.5	16.4	77	406	432	271	165	241	283	
51	I	15.1	8.6	9.3	18.0	78	410	628	252	248	252	248	
52	E	16.5	9.6	11.8	16.0	70	535	700	169	166	284	298	
53	A	16.0	9.6	11.4	22.2	75	392	940	302	296	334	297	
54	B	17.7	10.9	12.1	23.4	69	487	825	310	324	378	364	
55	D	17.5	10.1	12.1	20.0	70	603	514	246	232	353	330	
56	I	18.5	12.0	14.6	31.8	65	630	1410	386	356	286	328	
57	E	18.8	12.2	15.4	22.0	66	697	750	270	226	414	400	
58	A	19.2	13.1	18.5	24.2	59	790	827	354	396	410	376	
59	B	19.5	13.5	15.8	23.4	57	840	615	355	344	550	460	
60	I	20.6	14.5	15.3	28.6	56	962	1540	333	352	470	493	
61	A	16.6	10.5	11.7	24.0	68	421	1100	---	---	475	462	X-ray taken

TABLE 3 Page 3 - Acceleration & Load Data

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Shot No.	Subject	γ_1	δ	ϕ	t_o(sec)	f_n(c.p.s)
16	E	.086/.101= .84	2.1	.8	.128	3.9
17	D	.77	1.9	.8	.123	4.1
18	B	.75	2.1	.8	.120	4.1
19	C	.78	1.7	.8	.123	4.1
20	D	.82	1.7	.8	.122	4.1
21	E	.82	2.1	.8	.122	4.1
44	D	.71	1.6	.9	.123	4.5
45	H	.81	2.0	.8	.117	4.3
46	I	.79	2.0	.8	.121	4.1
47	D	.75	1.9	.8	.113	4.4
48	I	.87	2.0	.7	.130	3.9
49	B	.79	1.9	.8	.114	4.4
50	D	.86	1.9	.7	.110	4.5
51	I	.93	2.1	.7	.112	4.5
52	E	.87	1.7	.7	.100	5.0
53	A	.92	2.1	.7	.108	4.7
54	B	.96	2.1	.6	.115	4.4
55	D	.92	2.0	.6	.117	4.3
56	I	.97	2.5	.6	.109	4.6
57	E	.91	1.8	.6	.110	4.5

Definitions

γ_1 = ratio of elapsed time until peak response to total input pulse duration

δ = ratio of peak subject acceleration to peak sled acceleration.

ϕ = ratio of pulse length to natural period of the system (obtained from curves Fig 31).

t_o = natural peri

f_n = natural frequency of system.

Table 4 - Natural Frequency Variables

Test No.	Sub-ject	Phase	Total Measured Restraint Load (lbs)	Assumed Torso Acceleration (G)	Total Calc.Torso Load (lbs)	Total Measured Restraint Load as % of Calc. Torso Load	Total Shoulder Load as % of Calc. Torso Load	Total Lower Restraint Load as % of Calc. Torso Load	Ratio of Shoulder To lower Restraint Load
14	B	I	249	7.20	916	27.2	18.4	8.8	2.10
18	B	I	348	8.60	1086	32.0	22.0	10.0	2.20
22	B	I	404	9.60	1220	33.1	21.0	12.1	1.73
26	B	I	456	12.30	1560	29.2	15.8	13.4	1.18
30	B	I	632	12.90	1640	38.5	16.3	22.2	.73
34	B	I	633	14.20	1810	35.0	13.0	22.0	.59
37	B	I	907	16.00	2040	44.5	16.1	28.4	.56
49	B	II	819	8.70	1100	74.5	29.9	44.6	.67
54	B	II	1376	16.30	2070	66.4	30.6	35.8	.85
59	B	II	1709	20.20	2560	66.8	27.4	39.4	.69
12	D	I	242	4.80	515	47.0	24.8	22.1	1.12
17	D	I	388	7.20	772	50.2	24.5	25.8	.95
20	D	I	507	8.85	950	53.3	22.9	30.5	.75
24	D	I	573	10.35	1120	51.1	21.1	30.5	.70
28	D	I	554	12.30	1320	42.0	10.95	30.9	.35
32	D	I	623	11.05	1175	53.0	17.2	35.8	.48
36	D	I	828	14.05	1485	55.8	18.0	37.65	.47
38	D	I	941	15.75	1665	56.5	19.7	36.7	.53
47	D	II	608	8.25	781	69.8	23.2	46.6	.50
50	D	II	960	13.35	1410	68.1	29.9	37.2	.83
55	D	II	1161	15.15	1600	72.7	29.9	42.8	.70
16	E	I	405	7.20	770	52.5	23.5	29.1	.81
21	E	I	453	8.85	947	47.8	21.2	25.6	.87
25	E	I	595	10.35	1110	53.5	24.5	29.1	.84
29	E	I	625	12.30	1320	47.3	16.95	30.4	.55
33	E	I	624	13.05	1395	44.8	17.2	28.6	.56
52	E	II	917	14.40	1540	59.6	21.7	37.7	.57
57	E	II	1310	18.30	1960	67.0	25.3	41.5	.61

Table 5 - Relative Load Distribution

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Test No.	Subject	Maximum Sled Vel. (ft/sec)	Maximum Subject (ft/sec)	Difference Velocity (ft/sec)
3	A	6.9	9.8	2.9
4	B	6.8	8.8	2.0
5	C	6.9	9.5	1.6
6	D	6.8	7.8	1.0
7	E	6.7	8.1	1.4
8	A	9.6	11.8	2.2
9	B	9.6	11.1	1.5
10	C	9.6	11.5	1.9
11	E	8.5	10.9	2.4
12	D	9.4	11.2	1.8
14	B	11.1	12.5	1.4
15	C	11.1	12.8	1.7
16	E	11.2	13.3	2.1
17	D	11.3	14.2	2.9
18	B	12.3	15.6	3.3
19	C	12.3	15.2	2.9
20	D	12.4	15.6	3.2
21	E	12.4	14.8	2.4
22	B	12.9	15.0	2.1
23	C	13.7	17.2	3.5
24	D	13.9	16.9	3.0
25	E	14.0	16.5	2.5
26	B	14.5	16.2	1.7
27	C	14.4	17.2	2.8

Table 6 - Page 1 - Sled and Subject Relative Velocities

Test No.	Subject	Maximum Sled Vel. (ft/sec)	Maximum Subject (ft/sec)	Difference Velocity (ft/sec)
28	D	14.4	19.1	4.7
29	E	14.5	17.5	3.0
30	B	14.7	17.3	2.6
31	C	14.4	17.3	2.9
32	D	14.8	17.6	2.8
33	E	14.9	15.9	1.0
34	B	15.9	18.9	3.0
35	C	15.9	20.2	4.3
36	D	15.9	21.4	5.5
37	B	17.0	21.8	4.8
38	D	17.0	22.4	5.4
39	C	10.6	13.8	3.2
40	C	13.8	17.1	3.3
41	D	10.5	12.7	2.2
42	D	10.5	12.6	2.1
43	D	10.6	12.4	1.8
44	D	11.4	13.1	1.7
45	H	11.1	14.9	3.8
46	I	11.1	15.3	4.2
47	D	12.8	15.2	2.3
48	I	12.8	16.3	3.5
49	B	13.0	16.5	3.5
50	D	15.4	19.9	4.5
51	I	15.1	20.4	5.3
52	E	16.5	20.5	4.0
53	A	16.0	22.4	6.4
54	B	17.7	24.7	7.0
55	D	17.5	23.2	5.9
56	I	18.5	24.8	6.3
57	E	18.8	23.1	4.3
58	A	19.2	24.5	5.3
59	B	19.5	25.9	6.4
60	I	20.6	27.9	7.3
61	A	16.6	23.0	6.4

Table 6 - Page 2 - Sled and Subject Relative Velocities

Test No.	Subject	End Vel. (ft/sec)	Synopsis of Subjects Comments	Medical Analysis			
				Symptoms		Findings	
				Neuro	Skeletal	Neuro	General
3	A	6.9	No pain, felt jolt				
4	B	6.8	No pain, felt sudden jerk				
5	C	6.9	No pain, felt jolt				
6	D	6.8	No pain				
7	E	6.7	No pain, sudden jerk in stomach				
8	A	9.6	No pain				
9	B	9.6	No pain				
10	C	9.6	No pain				
11	E	8.5	No pain, felt stomach shift				
12	D	9.4	No pain				
13	A	10.1	No pain			one or more EEG bursts.	elevated blood pressure
14	B	11.1	No pain				
15	C	11.1	No pain				
16	E	11.2	No pain				
17	D	11.3	No pain				
18	B	12.3	No pain, more severe shot				premature atrial beat
19	C	12.3	No pain, felt good jolt				
20	D	12.4	No pain				
21	E	12.4	No pain				

Table 7 - Page 1 - Subjective Commen' and Medical Findings

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Test No.	Subject	End Vel. (ft/sec)	Synopsis of Subjects Comments	Medical Analysis: Symptoms		Medical Analysis: Findings	
				Neuro	Skeletal	Neuro	General
22	B	12.9	No pain, no worse than previous test, saw stars.				
23	C	13.7	No pain				
24	D	13.9	No pain, felt something in throat felt jolt.		Anterior neck pain.	one or more EEG bursts.	
25	E	14.0	Head pain not severe, felt jolt aroung pelvis	Head pain		one or more EEG bursts.	Premature ventricular beat.
26	B	14.5	Slight pain in chest, stronger jolt, saw stars				
27	C	14.4	No pain, felt pull in thighs and shoulders.				
28	D	14.4	Felt abdominal movement, slight throat pain.		Throat pain		
29	E	14.5	Headache after shot, felt load in shoulders.	Headache lasting <15 min.		Questionable EEG burst.	
20	B	14.7	More pull in stomach and lower abdomen.		Neck pain lasting > 24 hrs.		Premature ventricular beats.
31	C	14.4	Good jolt, felt some pain, muscle pull in lower obsipical area.				
32	D	14.8	Comparable to his last exposure, felt throat pain again.		Throat pain		
33	E	14.9	Headache, throat pain	Headache lasting >24 hrs.	Throat pain	Persistent dysrhythmia on conventional EEG.	
34	B	15.9	Felt pull in chest				
35	C	15.9	Good jolt, mostly felt in lower abdomen, also fullness of face.	Headache lasting <24 hrs.	Sore spine		
36	D	15.9	Good jolt, pain in throat		Throat pain	Dysarthria Bradycardia 30 min.	

Table 7 - Page 2 - Subjective Comments and Medical Findings

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Test No.	Subject	End Vel. (ft/sec)	Synopsis of Subjects Comments	Medical Analysis			
				Symptoms		Findings	
				Neuro	Skeletal	Neuro	General
37	B	17.0	Good jolt, back of neck hurt		Pain in back of neck		
38	D	17.0	Felt jolt in stomach, throat pain, momentary head pain.		Throat pain		
39	C	10.6	No pain				
40	C	13.8	Moderate jolt				
41	D	10.5	No discomfort				
42	D	10.5	No discomfort				
43	D	10.6	No discomfort				
44	D	11.4	Slight abdominal shift				
45	H	11.1	Severe abdominal shift up				
46	I	11.1	Abdominal shift up				
47	D	12.8	Severe internal abdominal shift up				
48	I	12.8	Abdominal shift up				
49	B	13.0	Abdominal shift up				
50	D	15.4	Good abdominal shift, pain in throat, raspy feeling like sore throat.		Pain in throat		Conjunctional flush 15 min.
51	I	15.1	Felt accelerometer on top of head, abdominal shift up				
52	E	16.5	Most improved ride				
53	A	16.0	Pain about breast bone, above and below, abdominal shift up		Neck Pain < 6 hrs.		Urine: rare RBC's
54	B	17.7	Pull in neck, jerky ride				
55	D	17.5	Large jolt in abdomen, pain in neck, pain in right rear of head lasting 2 min., dizziness		Throat pain Head pain		Urine: 8-10 WDB's 3-4 RBC's 30 mgm of protein
56	I	18.5	Abdominal shift up, felt pressure of accelerometer				
57	E	18.8	Slight headache, no pain	Headache			

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Test No.	Subject	End Vel. (ft/sec)	Synopsis of Subjects Comments	Medical Analysis			
				Symptoms		Findings	
				Neuro	Skeletal	Neuro	General
58	A	19.2	Strong loading in shoulder straps, smooth ride				
59	B	19.5	No pain, best ride				
60	I	20.6	Smoothest ride, felt pressure of accelerometer on head		Lumbar pain lasting > 24 hrs.		X-ray not remarkable
61	A	16.6	Back hurt		Dorsal pain lasting > 24 hrs, hospitalized		X-ray not remarkable

Table 7 - Page 4 - Subjective Comments and Medical Findings

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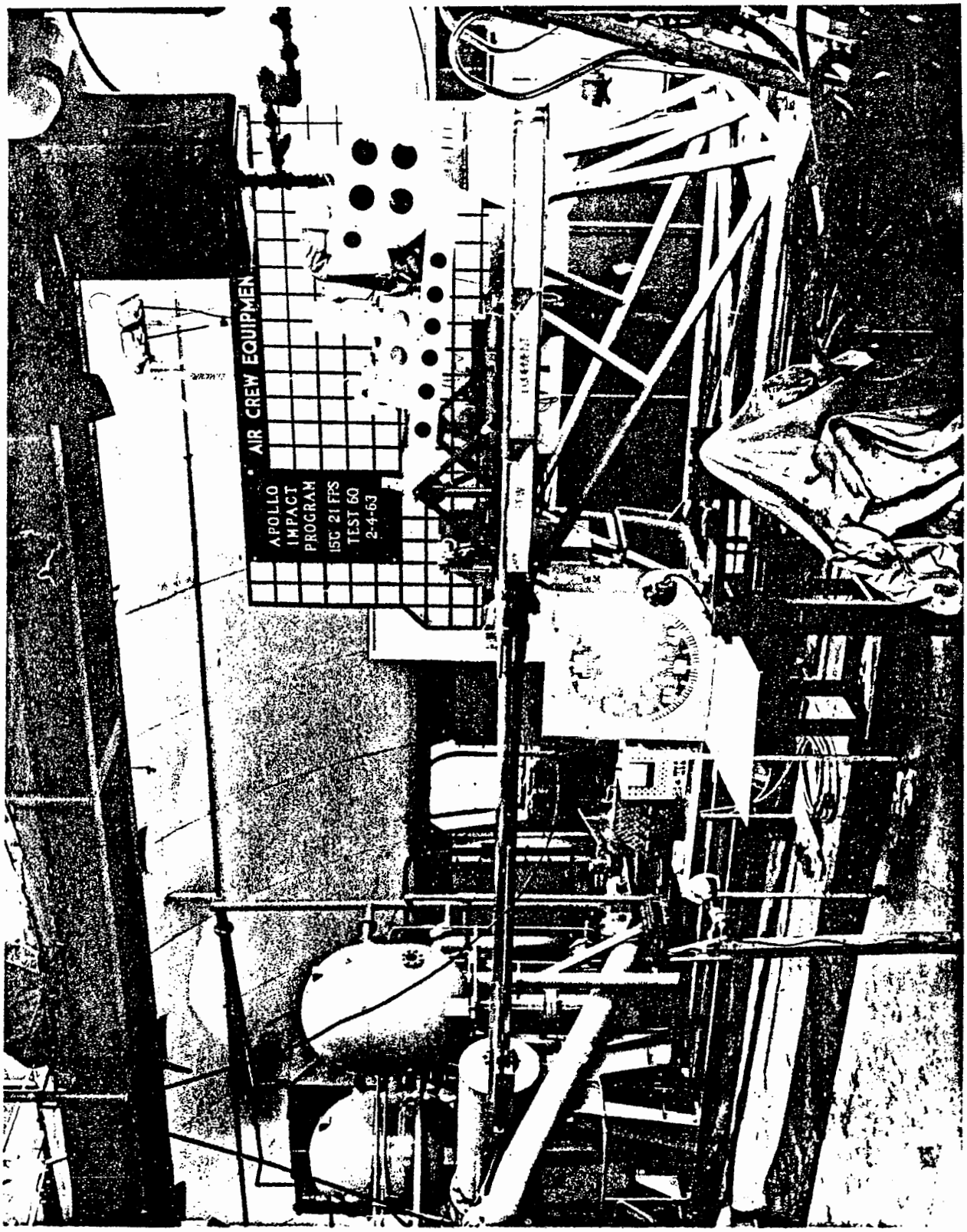
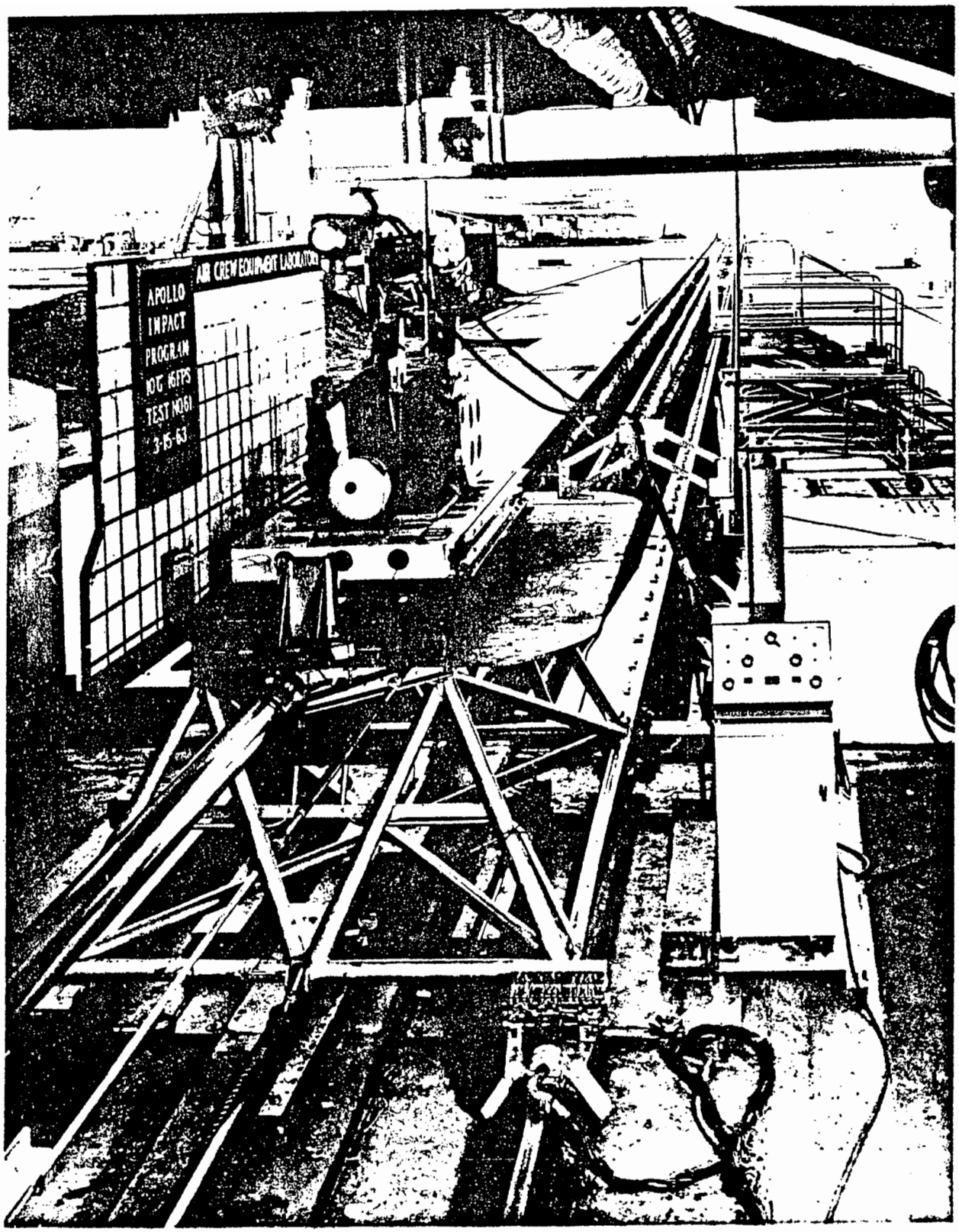


SLED SHOWN IN COCKED POSITION WITH SUBJECT READY FOR FIRING

PHOTO NO: CAN-349563 (L)-2-63

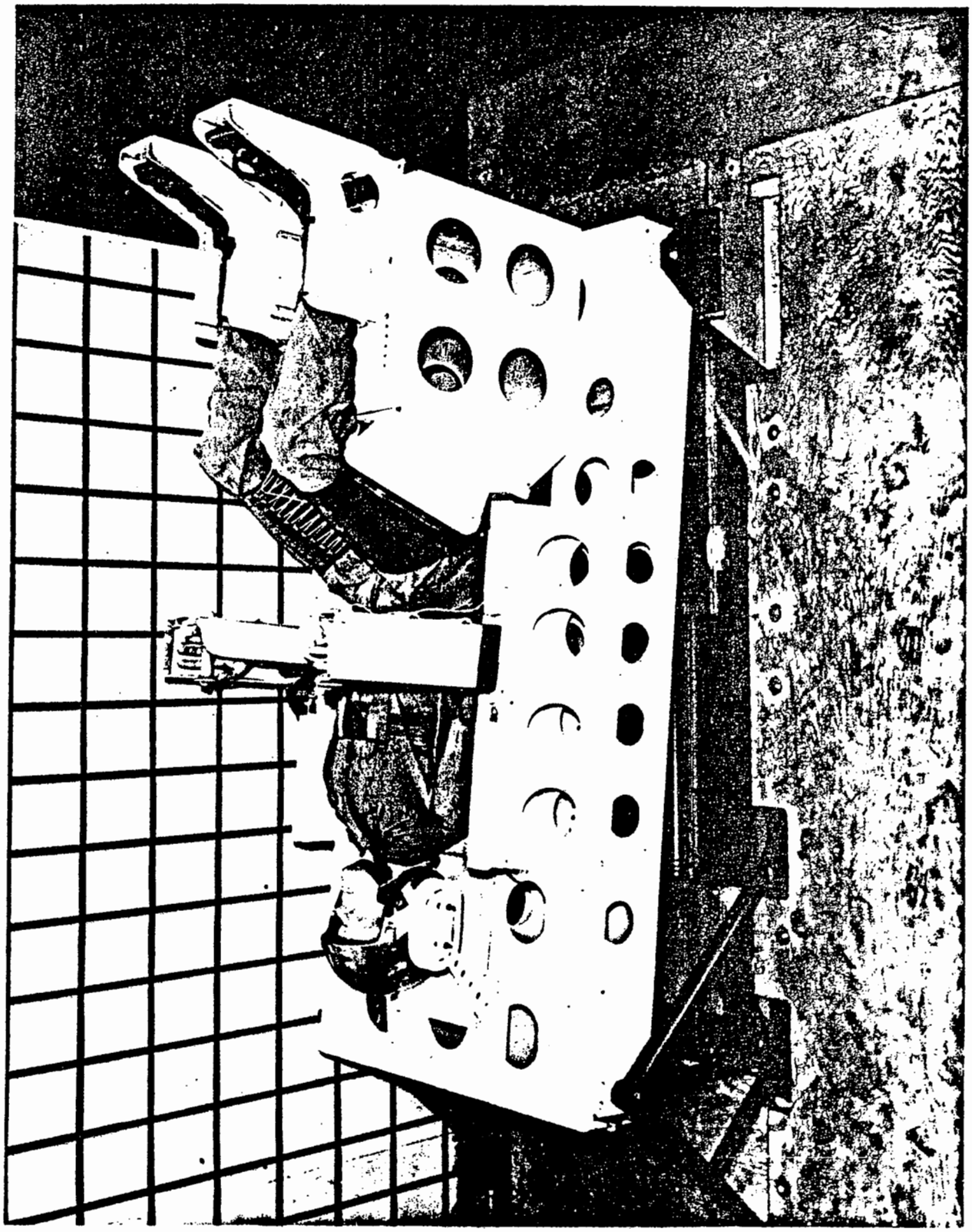
FIGURE 1



VIEW OF TEST SLED AND TRACK RUNOUT

PHOTO NO: CAN-350829 (L)-3-63

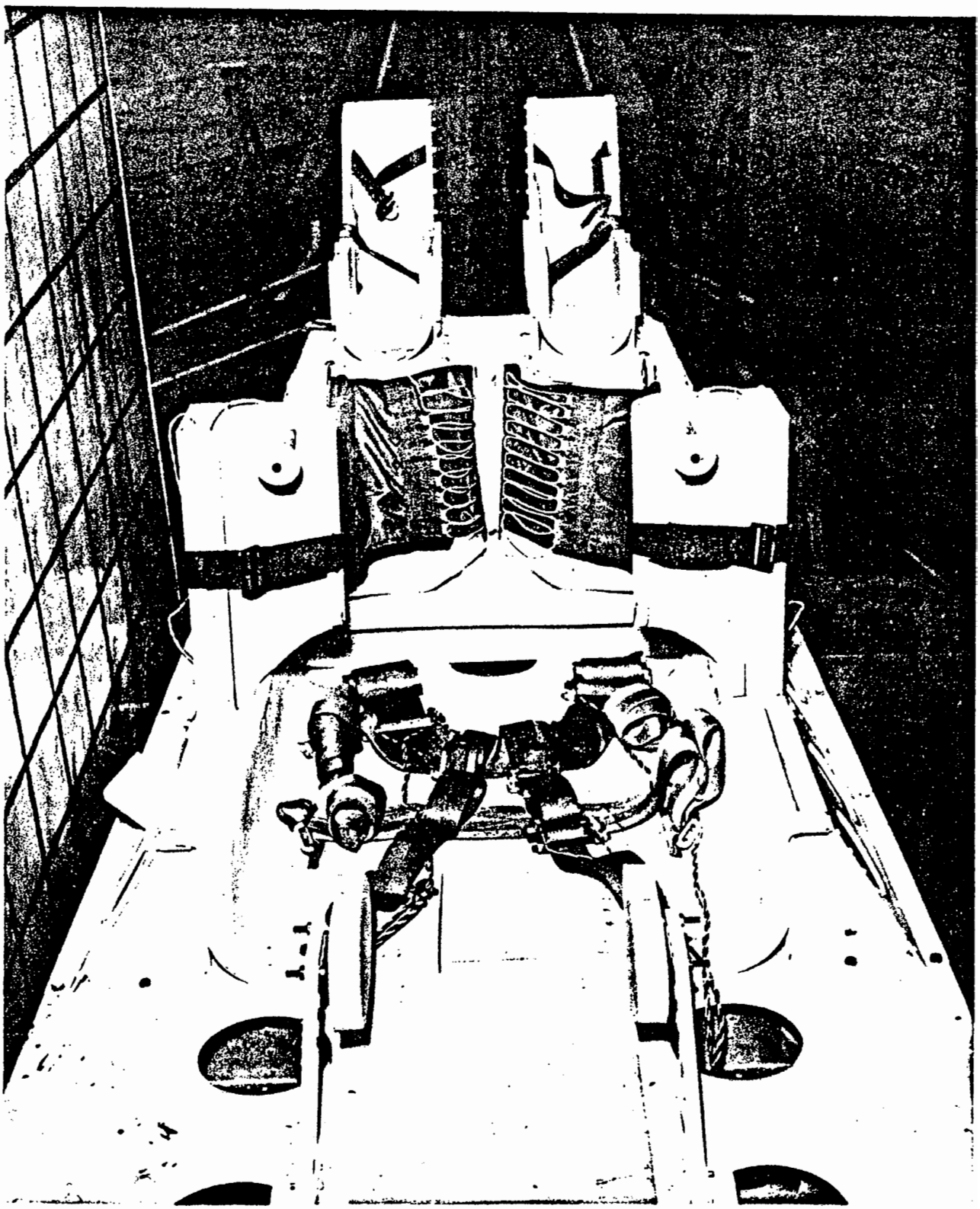
FIGURE 2



COUCH CONFIGURATION USED IN PHASE I OF STUDIES

PHOTO NO: CAN-346941 (L)-9-62

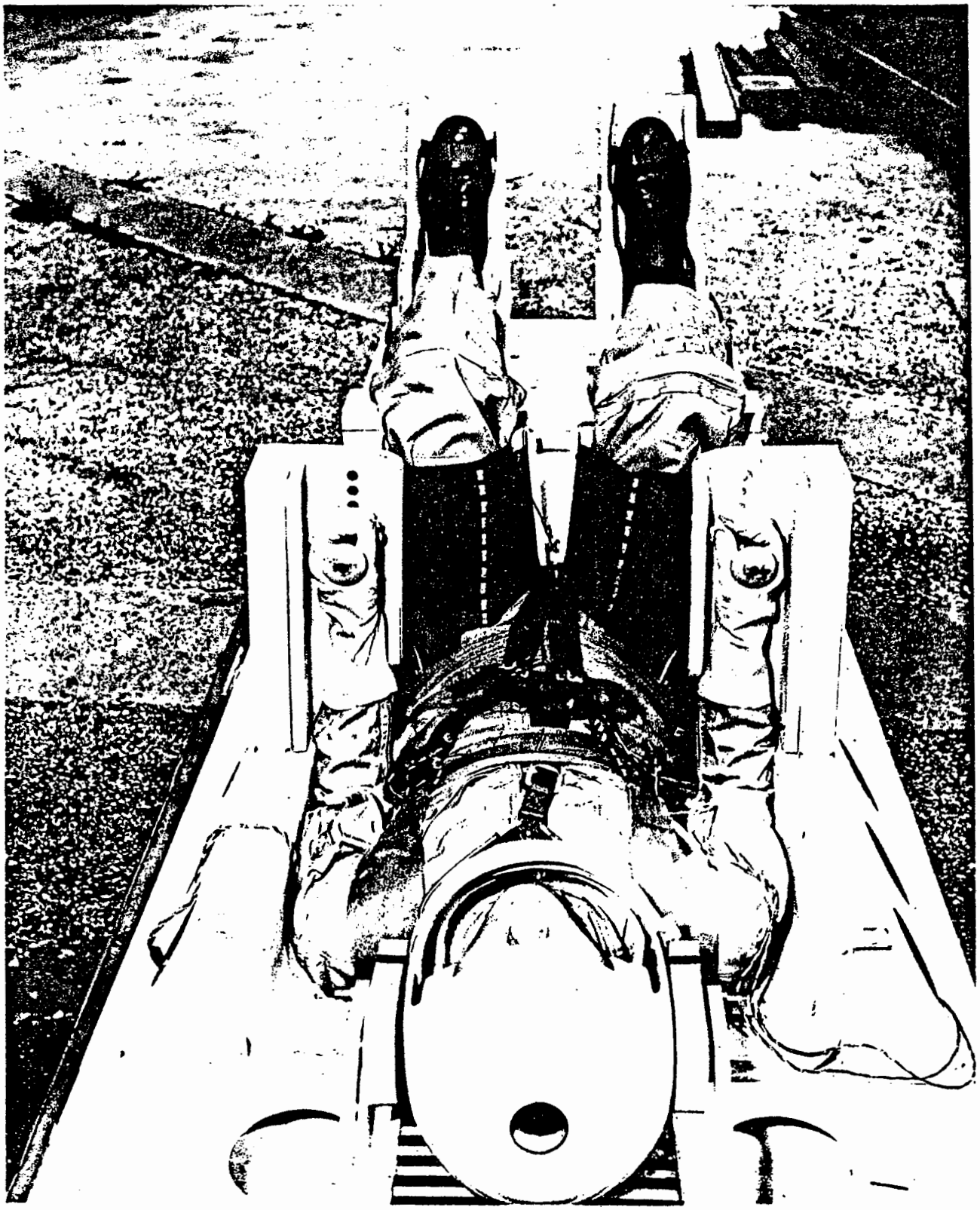
FIGURE 3



VIEW OF COUCH AND HARNESS RESTRAINT SYSTEM

PHOTO NO: CAN-346940 (L)-9-62

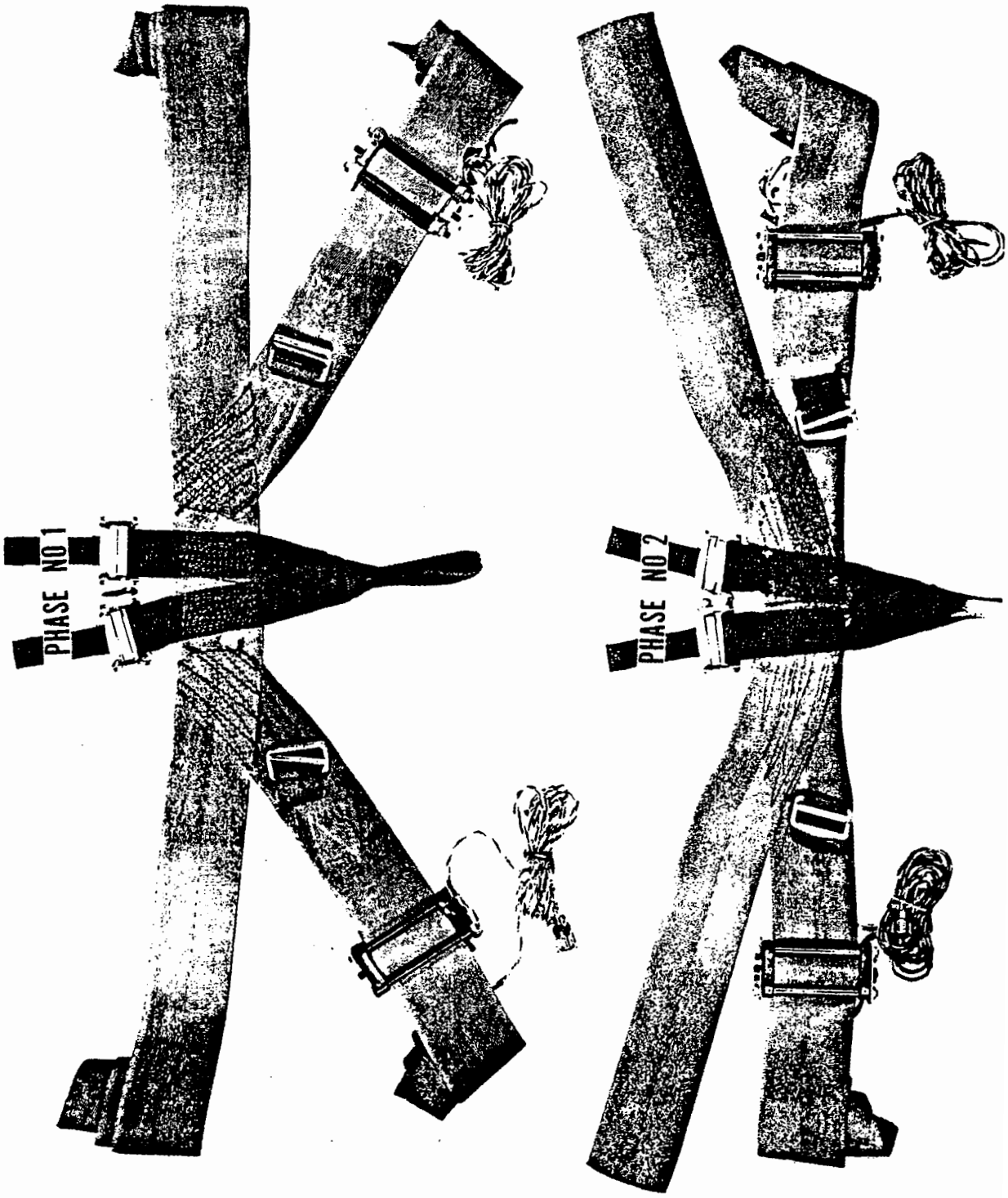
FIGURE 4



SUBJECT FITTED INTO COUCH AND SECURED BY RESTRAINT SYSTEM

PHOTO NO: CAN-350836 (L)-6-63

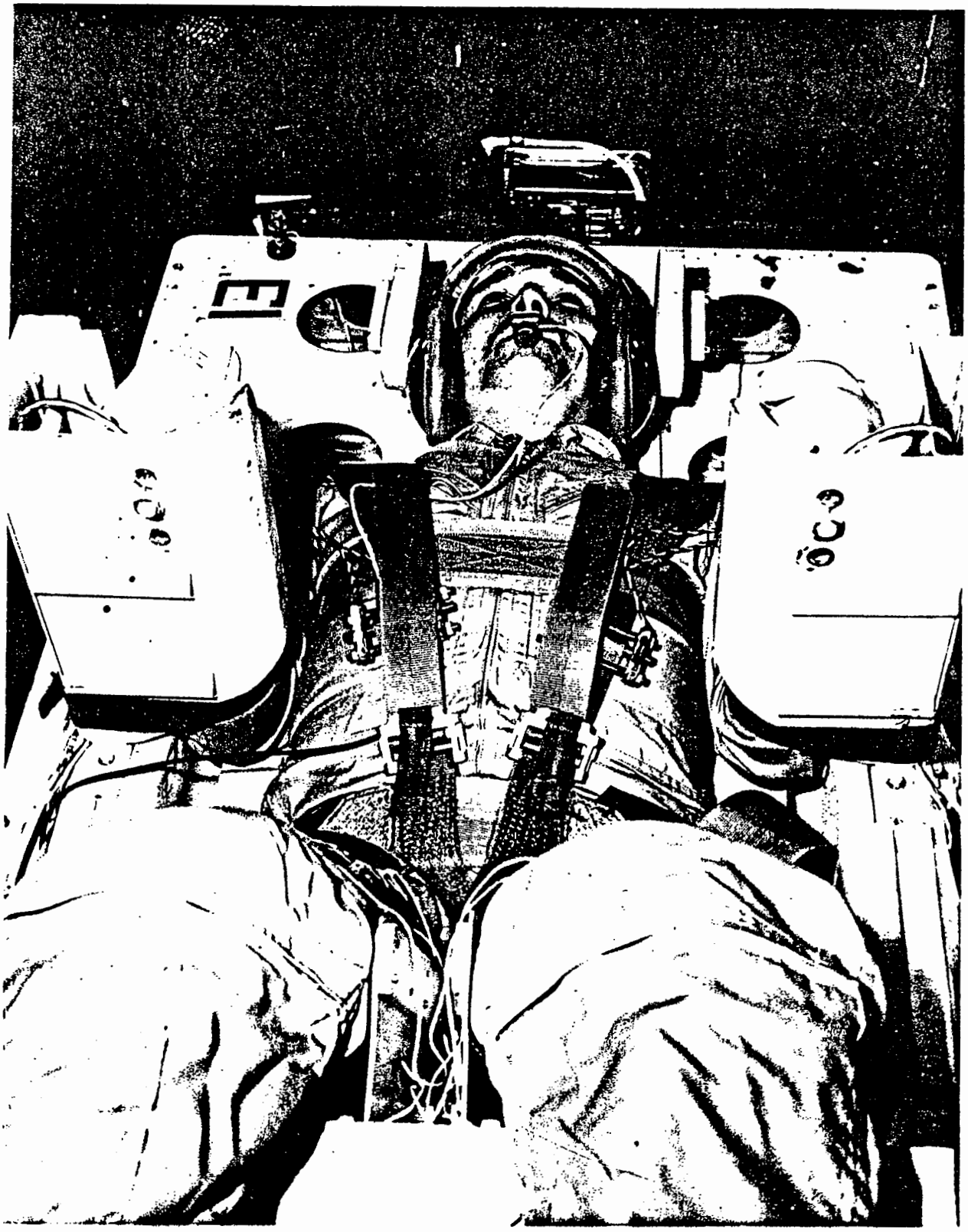
FIGURE 5



LOWER TORSO RESTRAINT HARNESS USED IN THE PROGRAM

PHOTO NO: CAN-347083 (L)-6-63

FIGURE 6



MOUTH ACCELEROMETER AND TENSIOMETERS POSITIONED ON SUBJECT

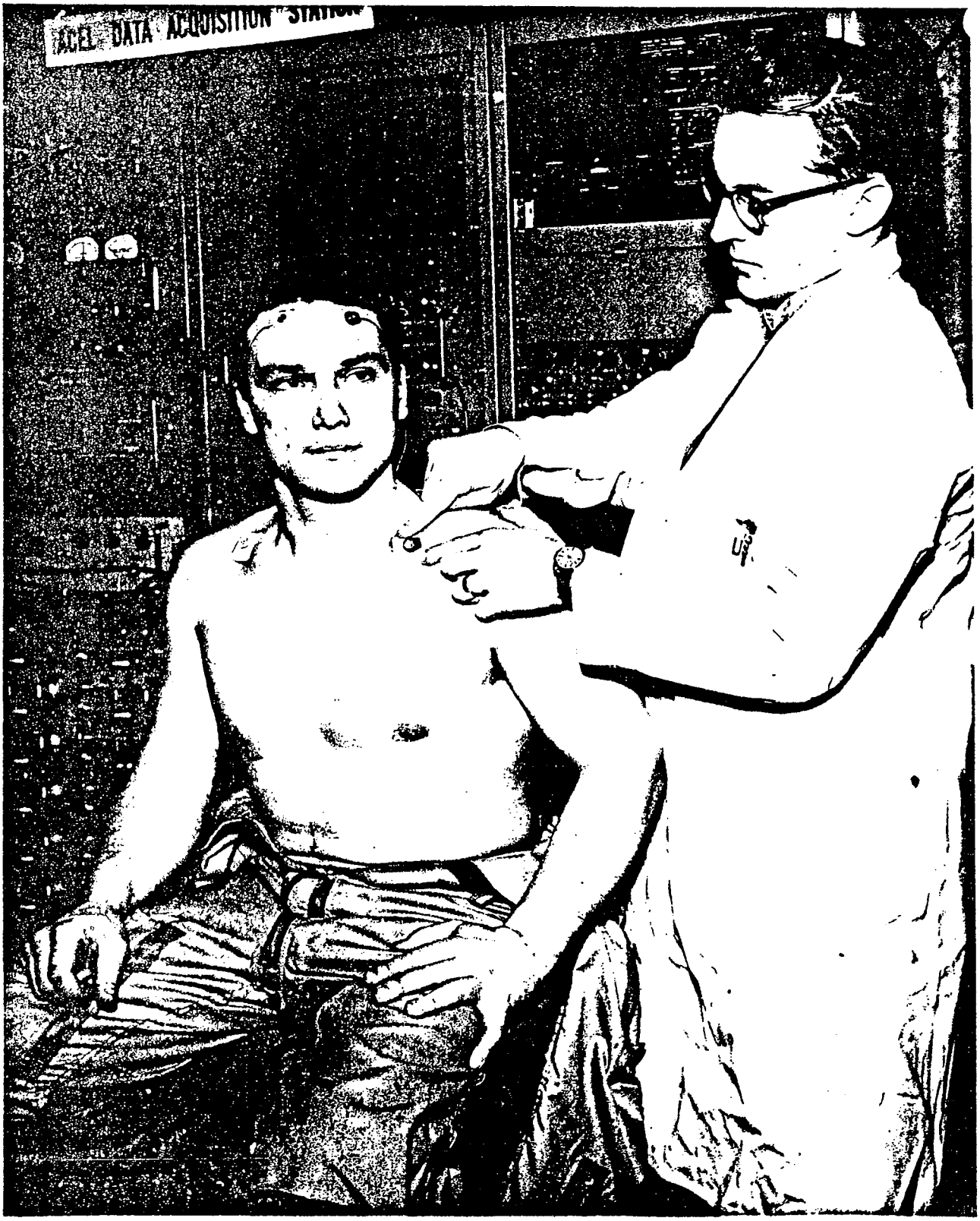
PHOTO NO: CAN-347083 (L)-9-62

FIGURE 7

HEAD ACCELEROMETER AND MERCURY HELMET TIE DOWN HARNESS

PHOTO NO: CAN-350841 (L)-3-63

FIGURE 8



ELECTRODE PLACEMENT TO OBTAIN ECG AND EEG DATA

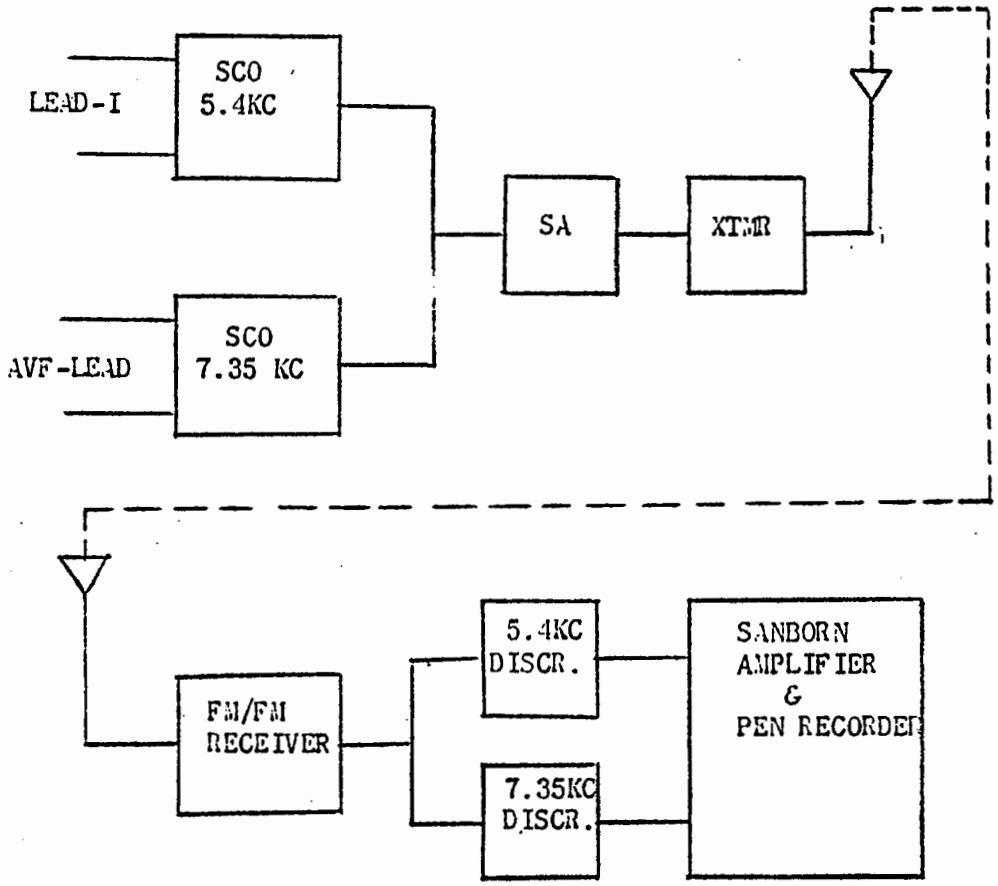
PHOTO NO: CAN-350831 (L)-3-63

FIGURE 9

ELECTRODE PLACEMENT TO OBTAIN AVF WAVE

PHOTO NO: CAN-350832 (L)-3-63

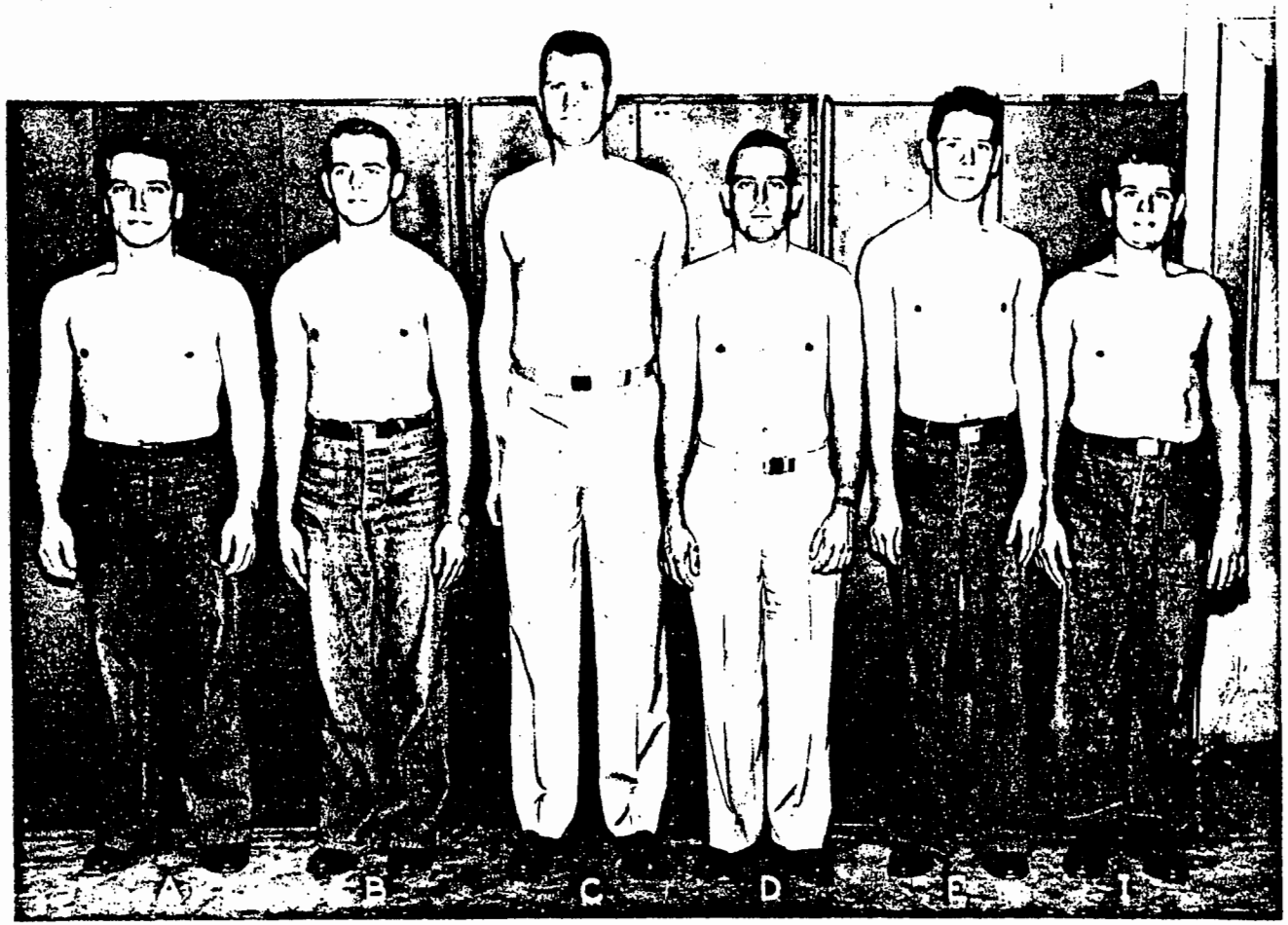
FIGURE 10



SCO SUB-CARRIER OSCILLATOR
SA SUMMING AMPLIFIER
XTMR RF TRANSMITTER
DISCR. DISCRIMINATOR

ACEL'S FM/FM TELEMETERING SYSTEM

FIGURE 11



ANTHROPOMETRIC DATA

SUBJECT	AGE	HEIGHT IN.	HEIGHT %ILE	WT. LBS.	SITTING HT. %ILE	SHOULDER WIDTH %ILE	BUTT-KNEE %ILE
A	21	66.5	4.5	187	25	95	20
B	22	68.7	26.5	182	70	89	26
C	31	75.2	98.0	225	96	99	98
D	32	67.0	7.2	152	50	65	5
E	20	70.5	53.5	153	90	30	17
I	21	65.8	2.0	175	30	90	8

PARTICIPATING SUBJECTS

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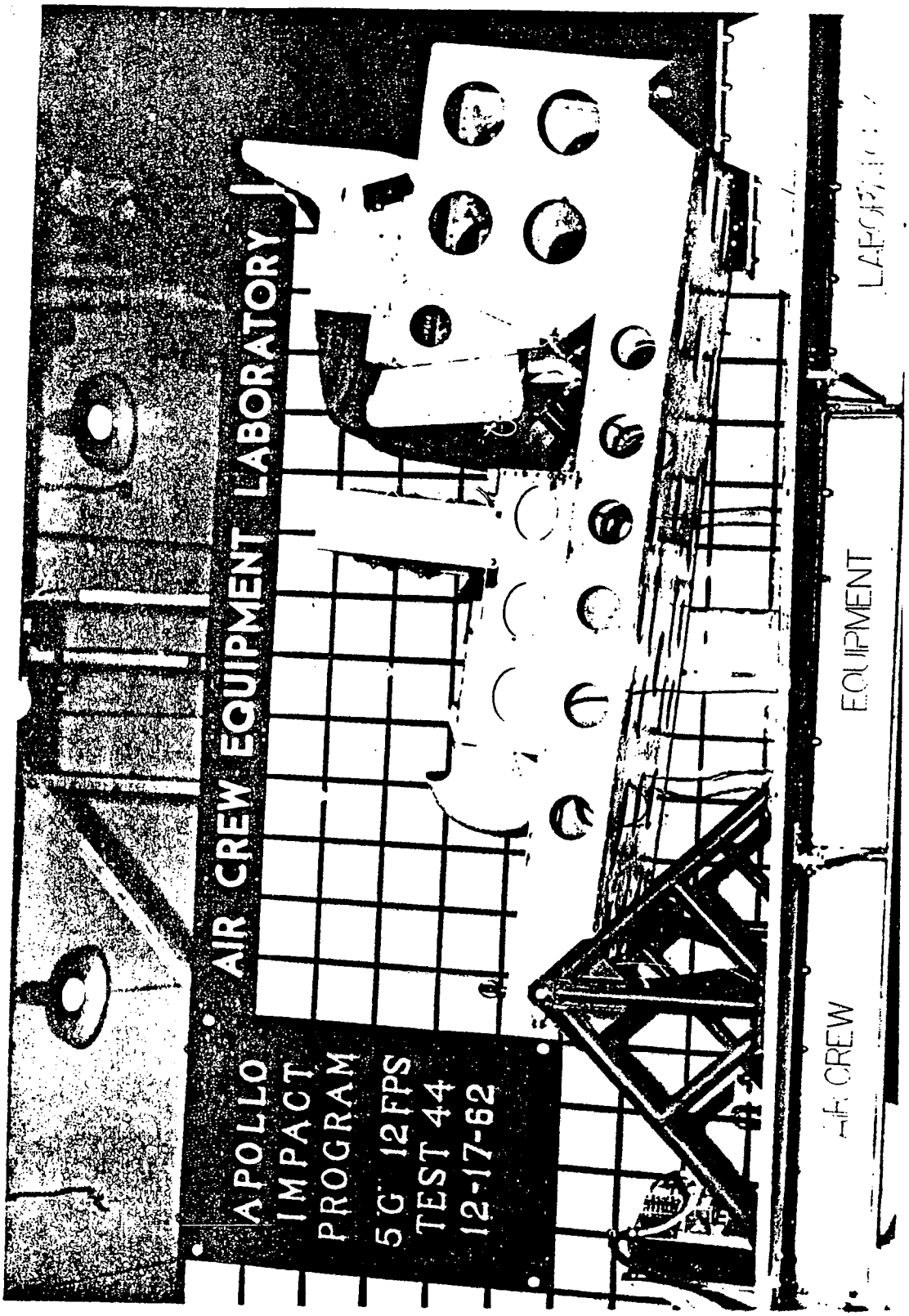

VIEW SHOWING ADAPTER INSTALLED TO CLOSE THIGH ANGLE IN PHASE II OF STUDIES

CAN-348654 (L)-12-62

FIGURE 13

FIGURE 14

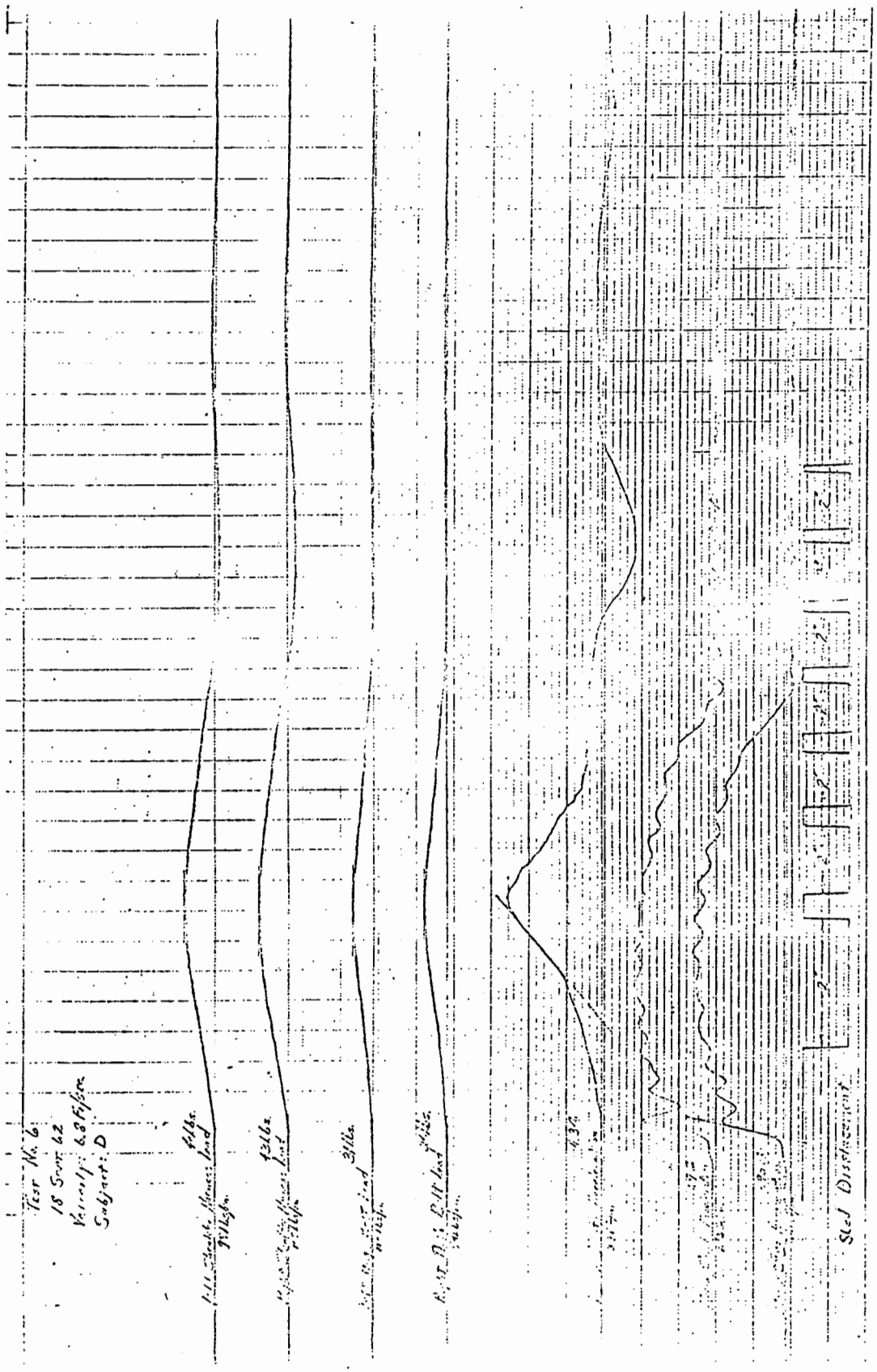
Test No. 6
18 Sept 62
Vertical 4.8 Kips
Subject: D
Pulse
Pulse
Pulse
Pulse
4.34
Sled Displacement

Fig. 15


Test No. 12
Subject: D
62 lbs
64 lbs
58 lbs
72 lbs
196
306
326
Sled Displacement

Fig. 16

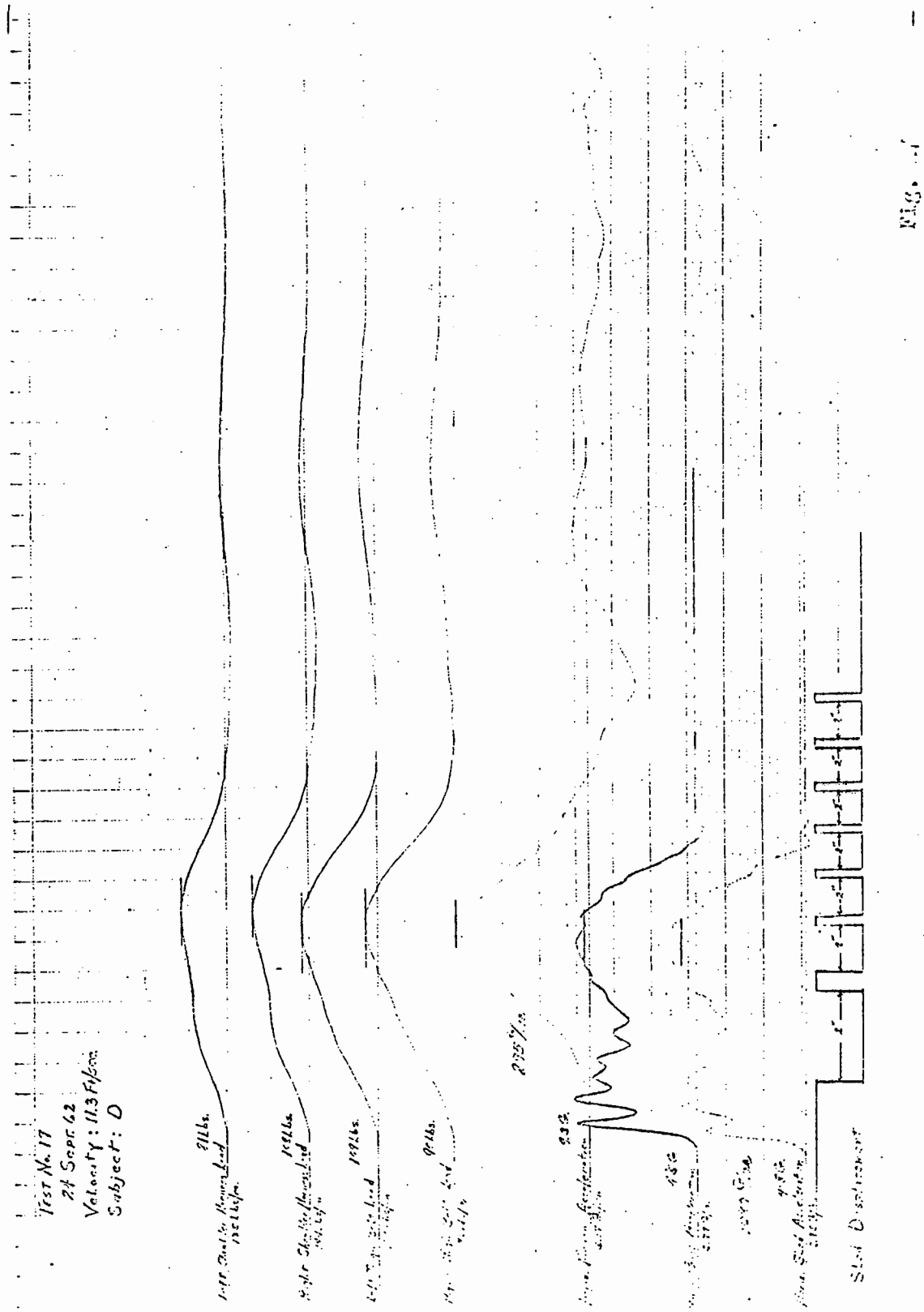
Test No. 17
24 Sept 62
Velocity: 11.3 Fps.
Subject: O
9 Lbs.
12 Lbs.
12 Lbs.
9 Lbs.
Stool Displacement

FIG. 1

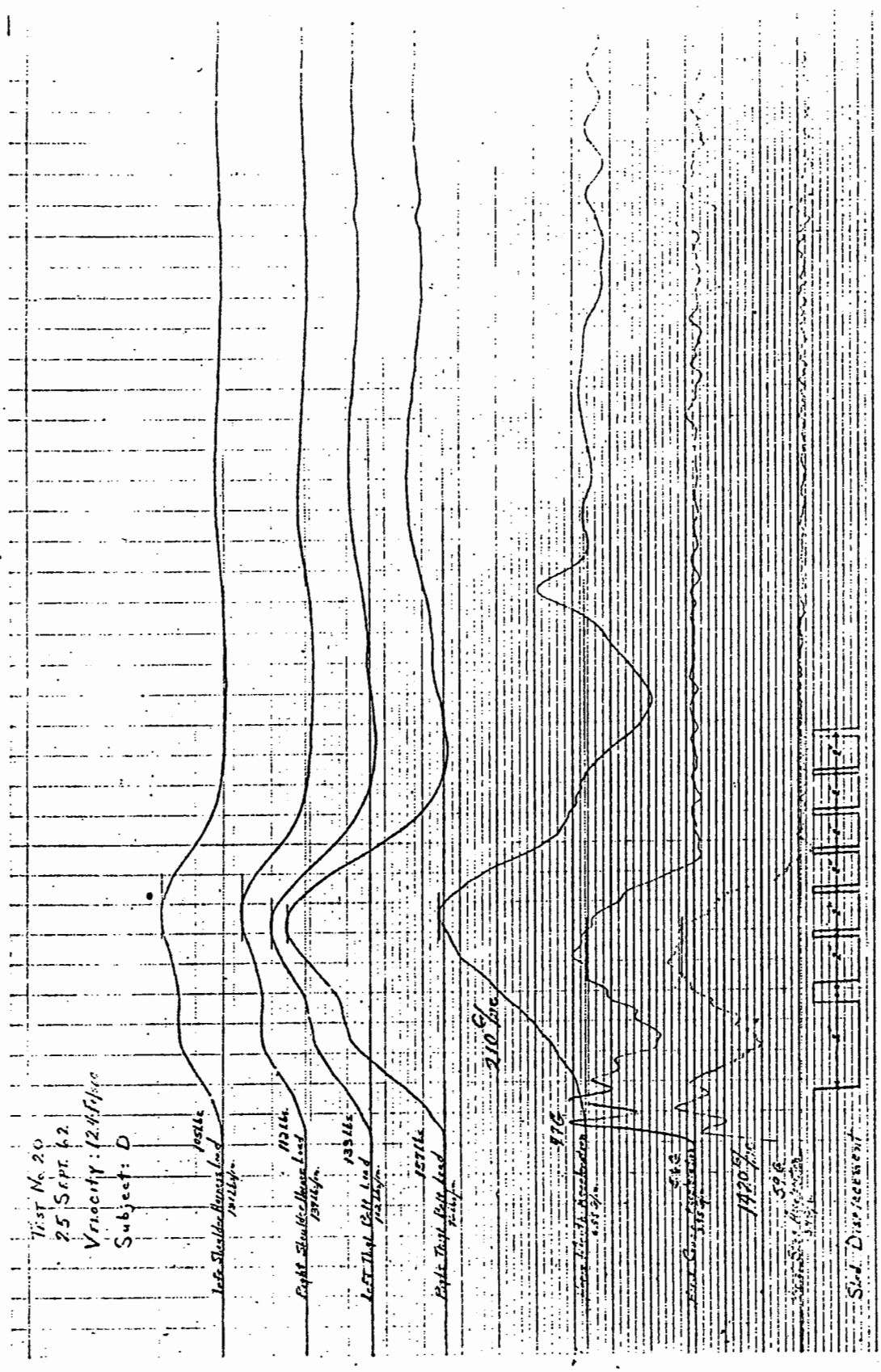
Test No. 20
25 Sept. 62
Velocity: 12.4 ft/sec
Subject: D
Left Shoulder Harness Load
Right Shoulder Harness Load
Left Thigh Belt Load
Right Thigh Belt Load
210 lbs.
Sled Displacement

Fig. 18

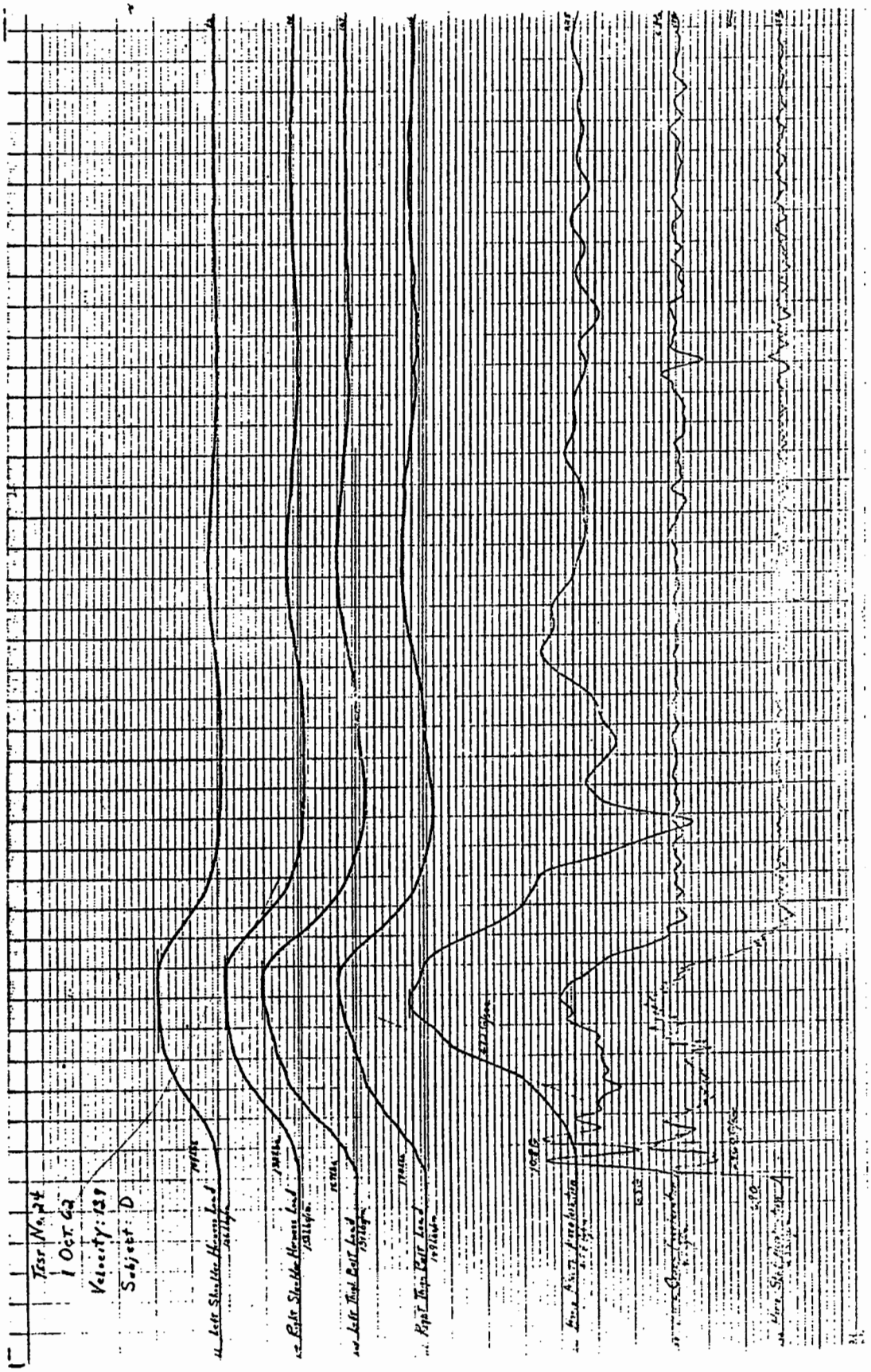

Fig. 19

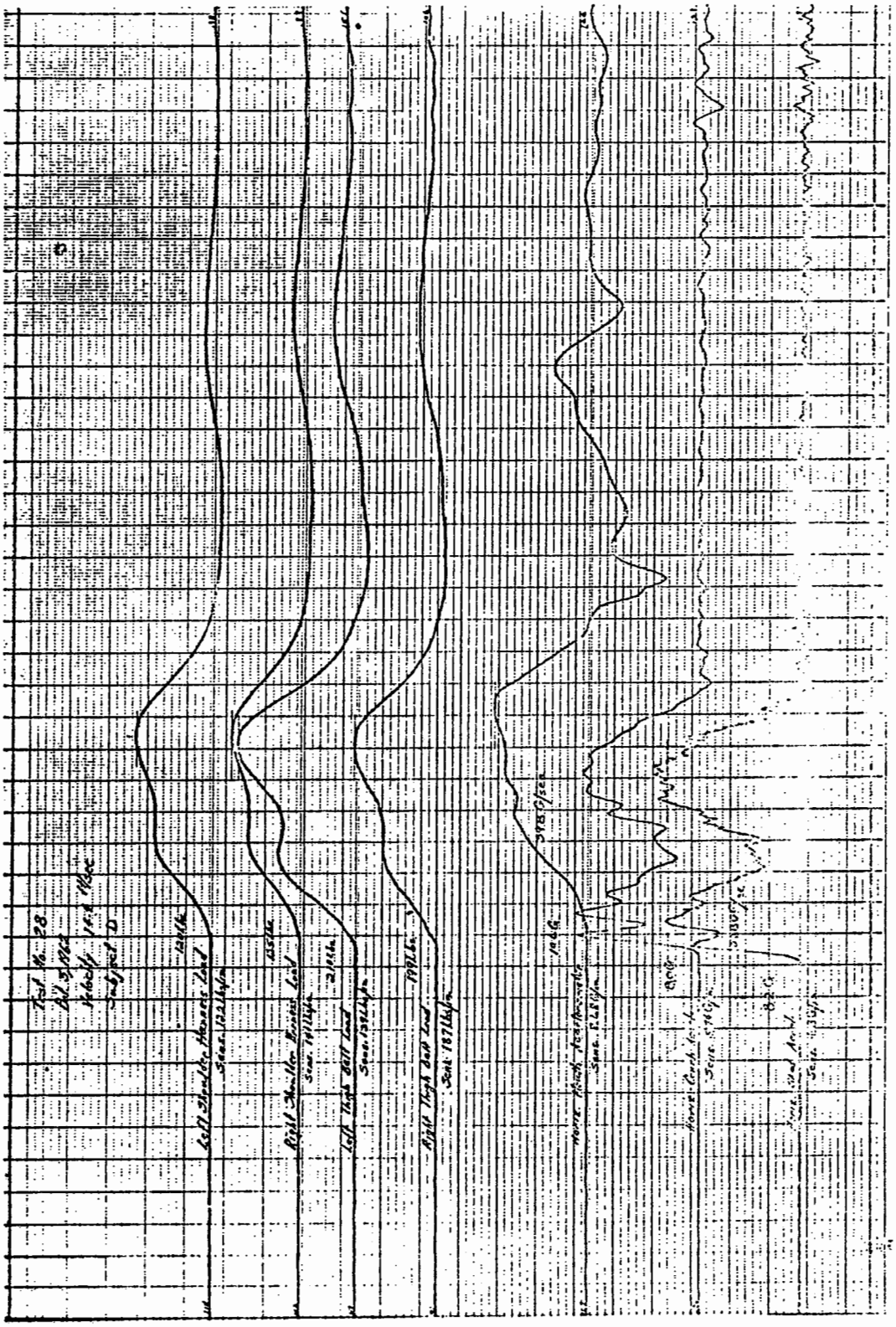

Fig. 20

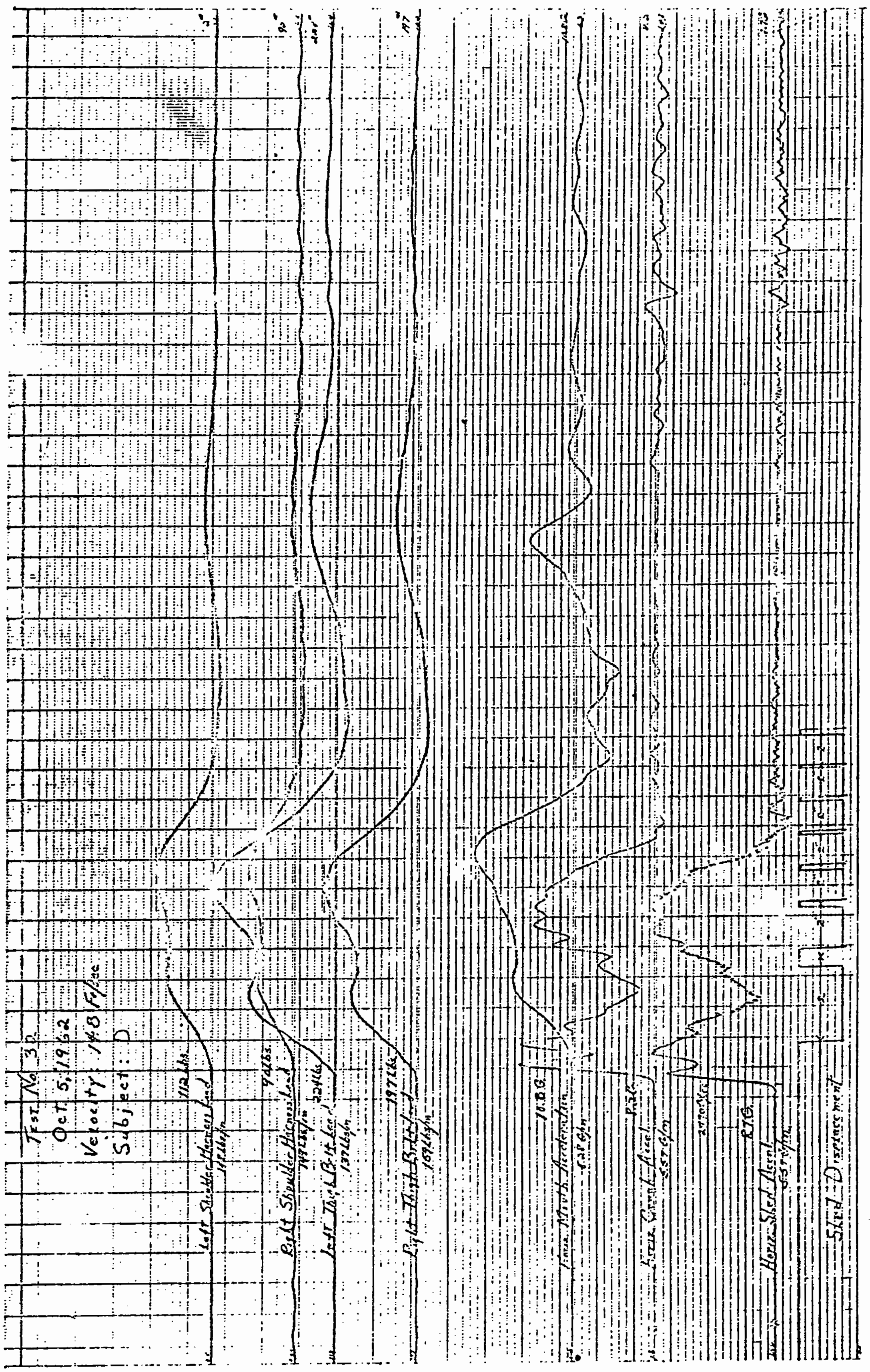
Test No. 3
Oct. 5, 1962
Velocity: 14.8 Ft/sec
Subject: D
Left Shoulder Harness Load
Right Shoulder Harness Load
Left Thigh Belt Load
Right Thigh Belt Load
Horiz. Mouth Acceleration
Horiz. Chest Accel.
Horiz. Sled Accel.
Sled Displacement

Fig. 21